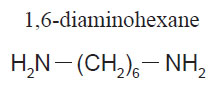
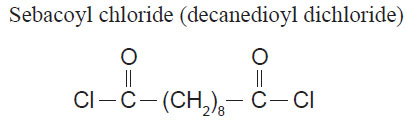
**Polymers**

**1.** A form of the polymer nylon can be made from the two monomers below.



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(i) Draw the repeating unit of the polymer formed if these two monomers are used

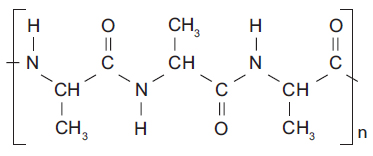
Consider the formation of this form of nylon in a laboratory.

(ii) Describe the type of reaction occurring, and explain why this reaction results in a polymer.

(iii) Explain why sebacoyl chloride is dissolved in a non-polar organic solvent rather than in water

(iv) Elaborate on the reaction that will occur if a dilute aqueous solution of acid is mixed with the newly formed polymer.

**2.** The following polymer will, under the correct conditions, hydrolyse.

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i) Draw the monomer(s) from which this polymer is formed.

ii) Discuss the hydrolysis of the polymer.In your answer you should include:

• the conditions under which it can be hydrolysed

• structures of the organic products formed as a result of hydrolysis.

**3.** The structures of Polymer A and Polymer B are given below.

**Polymer A **

**Polymer B **

**a)** Draw the monomers from which these polymers are made.

**b)** One of the polymers from above can be hydrolysed using NaOH(*aq*). Identify the polymer and draw

structures for the organic products of the hydrolysis.

**c)** Nylon 6,10 can be made from the monomers below.



Steps for the formation of Nylon 6,10 are given below:

1. 2 g of the diamine is dissolved in 25 mL of water.

2. 2.5 mL of sebacoyl chloride is dissolved in 25 mL of a non-polar organic solvent.

3. The dissolved sebacoyl chloride is poured into the diamine solution.

4. 5 g of NaHCO3 is added.

5. The nylon is extracted from the interface between the diamine and sebacoyl chloride layers.

• Identify the repeating unit of the polymer formed.

• Explain why the diamine is water soluble.

• Explain why the sebacoyl chloride is dissolved in a non-polar organic solvent.

• Explain why NaHCO3 is added.

**4. a)** Nylon 6,6 is a polymer with the following structure:



**i)** Circle an amide linkage in the structure above.

**ii)** Draw TWO monomers that could have formed this polymer.

**b)** Nylon 6 is formed from the monomer H2N–(CH2)5–CO2H.

**i)** Name this monomer and draw THREE repeating units of the Nylon 6 polymer chain

**ii)** Nylon is used for making ropes for climbing and abseiling. The ropes come with a warning label attached, such as that shown below.



Discuss why this warning label is attached to nylon rope when purchased.

Include in your answer:

• the type of reaction that would occur

• relevant organic structural formulae

• any changes to the properties of the nylon rope.

**5.** The polymer commonly known as Kevlar is used to make bullet-proof vests and bicycle tyres.

It can be made in a condensation reaction from either of the following pairs of monomers:



However, the second pair of monomers needs to be heated for the polymerisation reaction to take place.

Note: is a benzene ring and should be treated as a hydrocarbon chain. It is not a functional group and does not change during the reaction.

Discuss these polymerisation reactions.

Your answer should include:

• a repeating unit of the polymer chain

• reasons for the choice of monomers

• identification of the functional group in the polymer

• a reason why this is classified as a condensation reaction

• a comparison of the two pairs of monomers, including the reason that the second reaction will not take

place without heating.

**6. a)** Kodel is a polymer with the following structure:

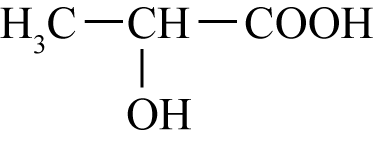


**i)** Identify TWO monomers for this structure.

**ii)** Explain why this type of polymer is known as a condensation polymer.

**b)** Compound **X** is a polymer which can be hydrolysed to give a single monomer, Compound **Y**, which has the molecular formula C3H6O3.

Draw a section of the polymer, Compound **X**, showing at least two repeating units.

**7.** Lactic acid is able to form a condensation polymer in the presence of dilute

sulfuric acid. Draw three repeating units of this polymer.

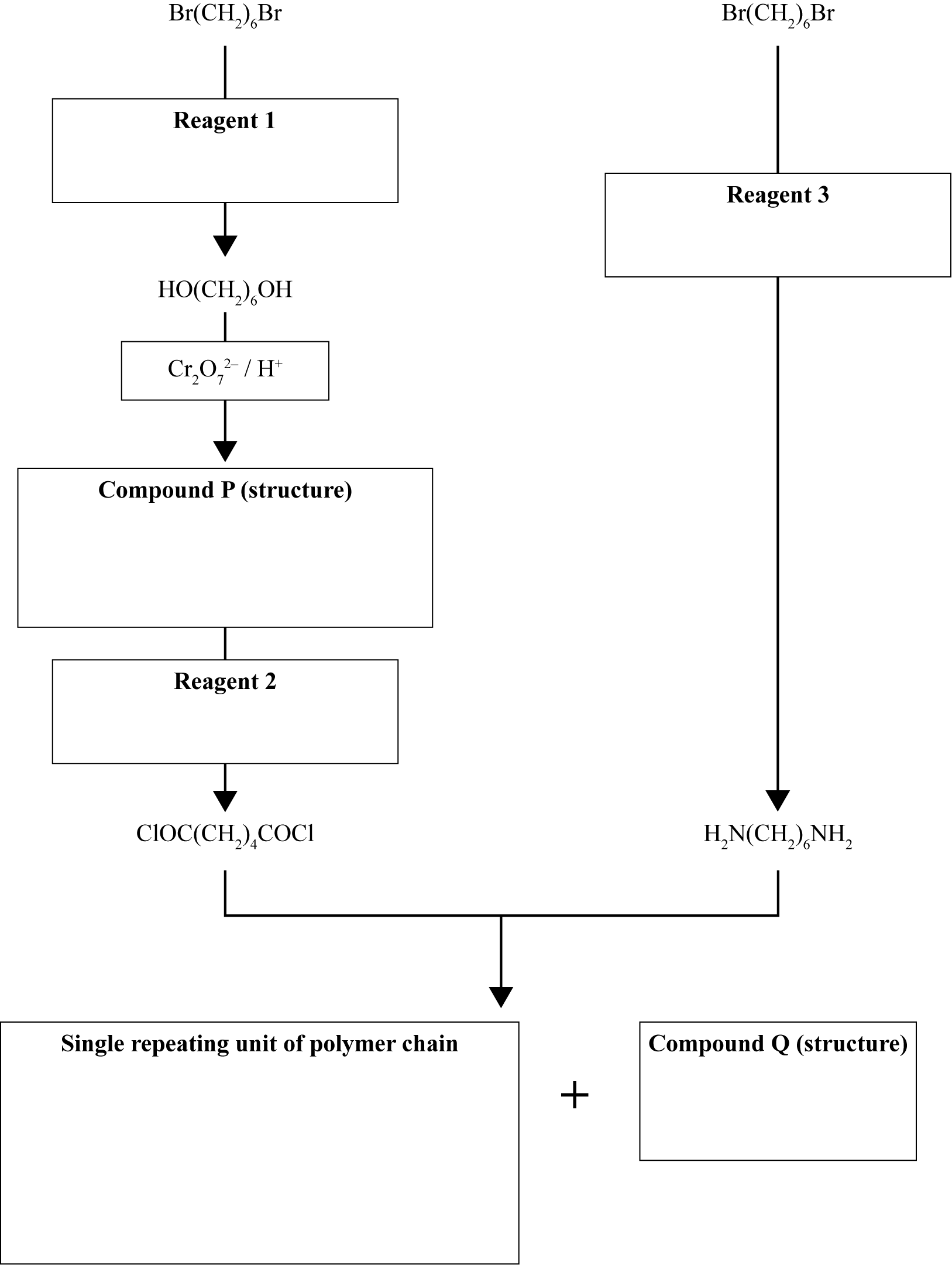
**8. a)** The reaction scheme below shows formation of a section of a nylon polymer chain. Complete the

reaction scheme by:

**i)** identifying reagents 1, 2 and 3,

**ii)** drawing the structures of compounds P and Q,

**iii)** drawing a single repeating unit for the nylon polymer formed.



**b)** Nylon is used as a fibre to manufacture ropes and fabrics. These products can be damaged if they

come into contact with acidic solutions. Teflon is a polymer formed from F2C=CF2 and is not affected by

contact with acidic solutions.

Discuss why nylon is affected by acidic solutions while Teflon is not. Use structural formulae and

equations where appropriate.

**9.** Consider the following statement.

***Polyesters*** *are* ***polymers*** *that can be made from two different* ***monomers*** *or from a single monomer.*

Discuss this statement, using the structures of specific monomers and the polyesters that can be made

from them, to illustrate your answer. Your answer should demonstrate a clear understanding of the

highlighted terms.

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